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EXHIBIT "A"

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

In Re Application of:

Thiel, James

Serial No.: **10/685,034**

Filed: **October 14, 2003**

Confirmation Number: **4886**

Group Art Unit: **2644**

Examiner: **Chau, Corey P.**

Docket No.: **252004-1031**

For: **System and Method for Adjusting the Low-Frequency Response of a Crossover that Supplies Signal to Subwoofers in Response to Main-Speaker Low-Frequency Characteristics**

DECLARATION OF JAMES THIEL
UNDER 37 C.F.R. 1.132

Commissioner for Patents
P.O. Box 1450
Alexandria, VA 22313-1450

Sir:

I, James Thiel, declare as follows:

Experience

1. I am an inventor of the above-identified patent application.

2. I have worked on many projects that involve speaker design, in the following manner: For 29 years I have been head of new product development for THIEL Audio Products Co. and have through that period developed more than 30 commercially successful loudspeaker products. These products have been honored with numerous awards including 21 CES Innovations Design & Engineering Awards. These products have earned an international reputation for high performance and innovative engineering. For example, Shane Buettner recently wrote in the Audio

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Perfectionist Journal "There are few companies in high-end audio with the well-deserved reputation for innovation and performance that THIEL Audio enjoys."

3. As indicated above, through my work in the electronics industry, I have gained extensive experience with speaker design.

Rejections Under 35 U.S.C. § 112, Second Paragraph

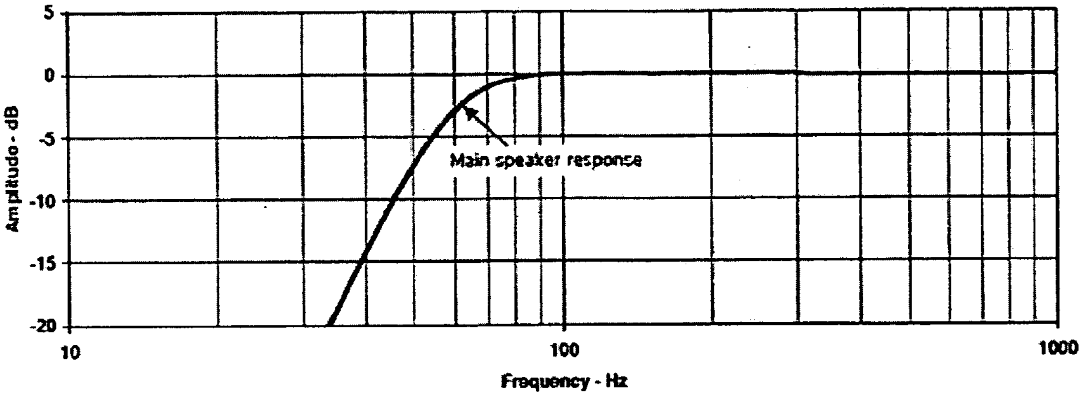
4. The Patent Examiner who is responsible for examining the above-noted patent application had the following comments to make on page 3 in the Claims Rejections section of the Detailed Action in the Office Action mailed December 19, 2005:

> Therefore, it is unclear to the Examiner how adjusting a low-frequency cutoff frequency, low-frequency damping factor, a speaker sensitivity factor, an enclosure type, and a gain factor does not change an output of the main speaker (providing information distinguishing how changing a user-adjustable variable being purely indicative of an intrinsic characteristic of the main speaker effects the main speaker compare to equalization parameters will provide a clearer difference between the invention and prior art). (OA p. 3, line 15)

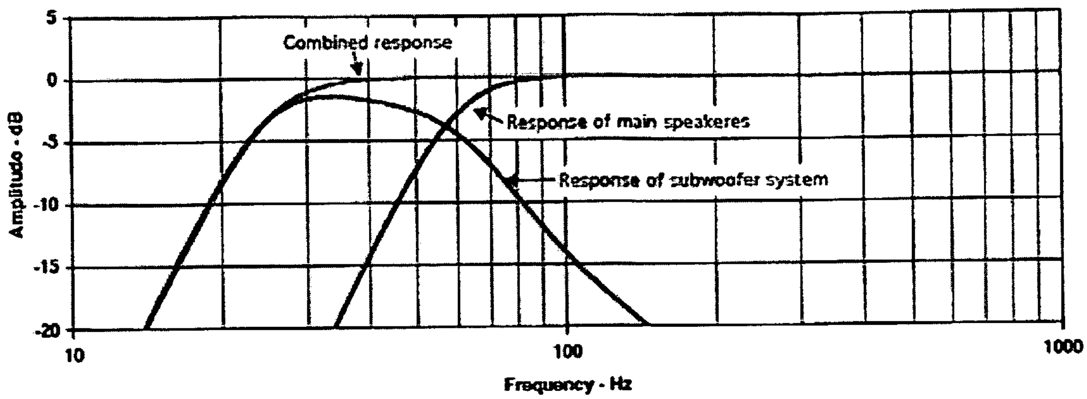
5. With regard to claims 1 – 38, and upon information and belief, I submit that one skilled in the art of speaker design, such as myself, would understand the present application to include a the following details:

Background

Many loudspeakers do not have a response characteristic that provides desirable levels of output at the lowest audible frequencies. For example, an otherwise high quality speaker may have a response that extends uniformly down to only 60Hz. A example of such a response is illustrated below.



Due to this inadequate response to the lowest frequencies of these speakers (hereafter referred to as "main" speakers) some audio systems incorporate a separate, specialized loudspeaker called a subwoofer that is capable of high quality reproduction of the lowest frequencies. In order for the sound output of the subwoofer to desirably blend with the sound output of the main speakers, its output can be limited to the frequency range that is not produced by the main speaker and furthermore, its output amplitude and phase characteristics can be such that the subwoofer output and the main speaker output combine in a desirable way, usually with uniform output across the entire range. Such a system performance is illustrated here by showing the response of the main speakers, the response of the subwoofer system and the combined response of both.



The response of the subwoofer itself will typically extend to a much higher frequency than is desirable for such proper total system operation. Therefore, to achieve a desirable output response from the subwoofer, a separate apparatus, termed an equalizer, is connected in the signal path to the subwoofer so that the subwoofer's signal travels through the equalizer. An equalizer used for this subwoofer response application is often referred to as a "crossover". Such an electronic crossover is often built into the same enclosure as the subwoofer. The equalizer can be configured to have its own frequency response such that, when added[1] to the subwoofer's response, gives a desirable subwoofer system response (that of the subwoofer and the equalizer together). This is illustrated in the following graph that shows the response of the subwoofer, the response of the equalizer and the combined subwoofer system response that was illustrated in the previous graph.

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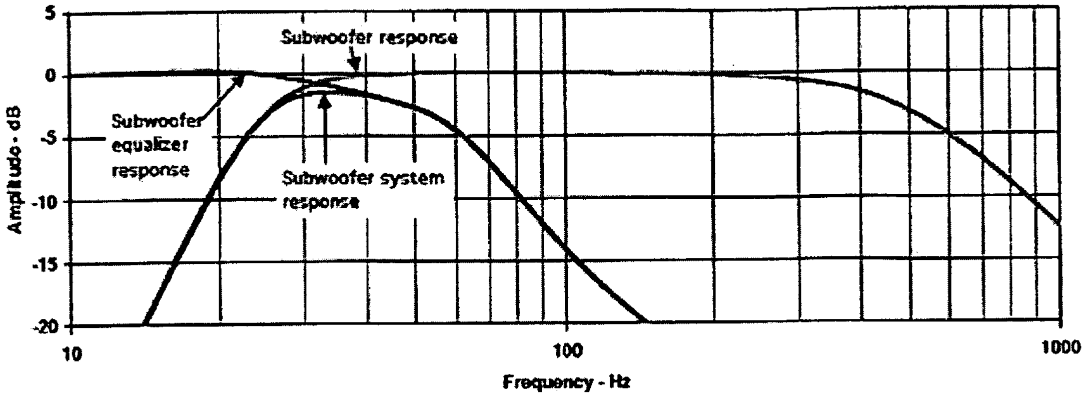
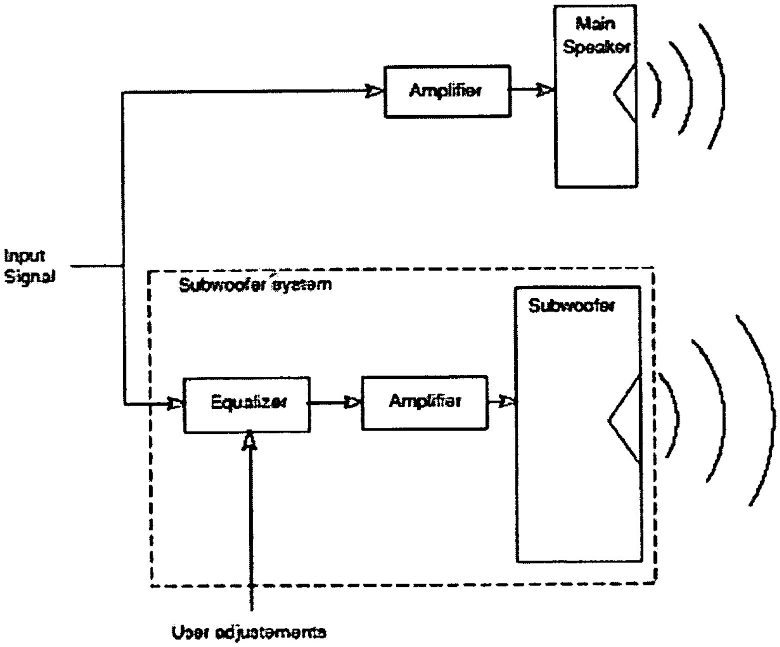
[1] "added" is commonly used to describe the alteration of the total system frequency response because the change in output caused by the device is calculated by adding the devices' responses *in dB*. However, this operation is really a multiplication of the signal by the device's amplification factor.

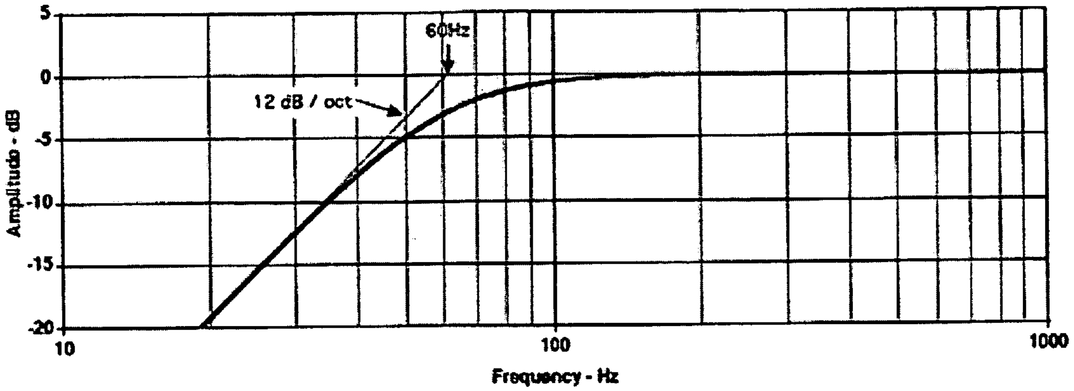


The subwoofer is usually required to achieve proper blending with a variety of main speakers that exhibit different response characteristics and therefore is required to provide an adjustable range of frequency response characteristics that can be adjusted to meet these different requirements. Therefore, in order to provide controllable and variable subwoofer output response characteristics, user adjustments are provided on the equalizer so that the user can adjust the response of the complete subwoofer system as required.



In prior art the equalizer's response is controlled by user adjustable variables (knobs or other settings) that describe the response of the equalizer itself. The user adjustments may include those that select the type of response (lowpass, highpass, parametric, etc), the characteristic frequency, Q, gain, and possibly other variables. In all cases the user adjustments are describing the equalizer's frequency response characteristics and do not describe the response of the device that the equalizer is being used with. For example, if the user sets an equalizer variable control to 40Hz, this controls a characteristic of the equalizer's response; it does not describe that the speaker whose response is being equalized has a 40Hz characteristic. Further, in subwoofer crossover applications, the user adjustable settings do not describe anything about the response of the main speakers that the subwoofer system is being used with.

Let us now return to the beginning consideration, the matter of the response of the main speaker. Whatever the frequency response characteristic is (whatever the shape of the response curve), there are reasons for the response in the physical attributes of the loudspeaker. For example, in the example illustrated below, the fact that the response decreases at lower frequencies along a line (shown dotted) that intersects the line of response at higher frequencies at the 60 Hz point, rather than some other frequency, is because the speaker's mass of moving parts and the motional compliance of its moving parts resonate at 60 Hz. As another example, that the low frequency response decreases at a rate of 12 dB per octave is because this speaker is in an enclosure that is "sealed", or approximately air tight.



So:

1. A loudspeaker possesses physical attributes such as a specific mass of the parts that move to create sound, for example 50 grams.

2. These physical attributes cause the loudspeaker to exhibit specific intrinsic properties (intrinsic to the physical object of the speaker), for example a 60 Hz resonance frequency. These intrinsic characteristics are not the same as the output that is delivered by the speaker. If the speaker's input signal is altered, that will cause its output to be different but will not have changed the speaker's intrinsic characteristics.

3. These intrinsic characteristics cause the loudspeaker to exhibit a specific frequency response, for example a 60Hz 2nd order highpass response. Intrinsic characteristics are not the same as the response; a driver enclosure that is sealed is not the same thing as a 2nd order high pass frequency response.

To describe the complete audio system being considered:

1. There are main speakers that possess intrinsic properties that result in a particular frequency response.

2. There is also a separate subwoofer speaker, which is used in conjunction with an equalizer (crossover) which modifies the subwoofer's signal.

3. The frequency response of the subwoofer equalizer is user adjustable for the purpose of providing a subwoofer output that will combine with the sonic output of various main speakers in a desirable way.

4. The subwoofer equalizer response is determined by user adjustable settings that describe the response of the subwoofer equalizer. The cited art accepts user input that describes and indicates the equalizer's own frequency response.

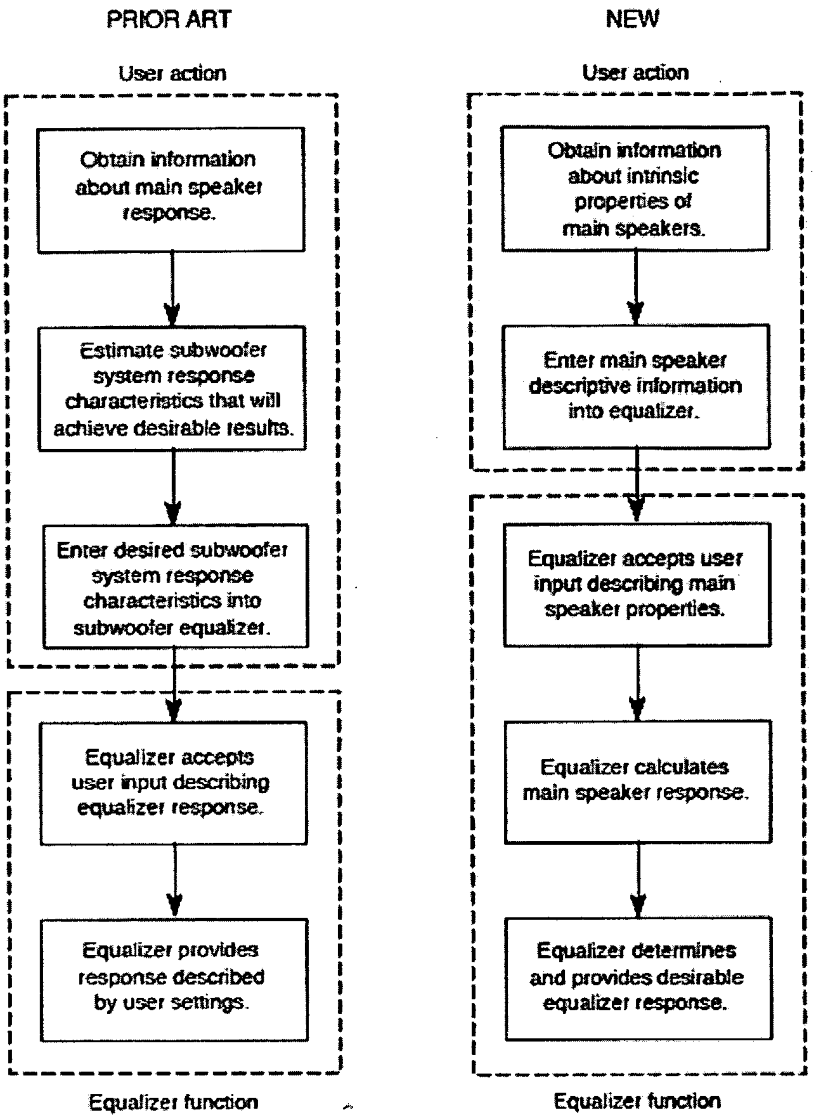
5. It is left to the user to decide what subwoofer equalizer response settings will provide a subwoofer response that will combine desirably with the output of the main speakers. As is true in the use of all user-adjustable equalizers, the user may consider the characteristics or response of the main speakers in his decision of what subwoofer equalizer response to specify, but using that information to make a decision is not the same as entering that information into the equalizer.

Summary

The present application concerns a device that implements a new method for user control of the equalizer's response characteristics. The novelty is that the equalizer's user adjustable variables do not describe the equalizer's response, as in all prior art, but rather describe intrinsic characteristics of a loudspeaker. Using this different type of information, the device automatically configures its operation to provide response characteristics, which are not described by the user adjustable variables. In particular, the information inputted into the device through the user adjustable variables that is descriptive of the intrinsic characteristics of the main speakers can include for example, the main speaker's enclosure type (the box the speaker driver unit is mounted into), the main speaker's low frequency cutoff frequency, the main speaker's low frequency damping factor and the speaker's sensitivity factor. This information is descriptive of main loudspeaker intrinsic characteristics and not descriptive of the equalizer's response.

An illustrative example will possibly make the fundamental difference between prior art and the present invention clear. Using a prior art system the user might obtain response information about the main loudspeaker either by acoustic measurement, listening or product specifications. He then will estimate, possibly based on an intuitive or explicit calculation using response information about the main speakers, what subwoofer response characteristics might provide good total system (main and subwoofer speakers) performance. For example, he may decide that he wants the subwoofer's response to exhibit a 50 Hz 4th order lowpass characteristic with 45 degrees of phase delay. He then enters this response description into the subwoofer's equalizer, typically adjusting one setting for 4th order, another setting for 50 Hz, another for 45 degrees and another setting for a gain factor. He then evaluates the quality of the system performance achieved, possibly by listening or by performing acoustic measurements. If he is not satisfied with the results he will then re-estimate what equalizer response might provide better results and then enter that equalizer response description into the equalizer and try again.

By contrast, when using the present invention the user first determines several intrinsic properties of the main speakers such as its enclosure type, low frequency response limit, low frequency damping and sensitivity. This information is obtained by consulting the product information sheet or by other means. Then the user enters this main speaker descriptor information into the subwoofer equalizer of the present invention. The present device then processes this speaker descriptor information (not equalizer response information) to determine what the response characteristics of the main speaker are and automatically configures itself to provide subwoofer equalizer response characteristics that will cause a desirable blending of the subwoofer's output with that of the main speaker's output. The user does not know what subwoofer equalizer response characteristics are being provided by the device, the very information that usually must be entered into the device. Another advantage of the present device is that the equalizer's possible response characteristics are not limited to those that are conveniently describable by user input settings but instead can be any response characteristics that will provide the desired result.


PRIOR ART
User action
Obtain information about main speaker response.
Estimate subwoofer system response characteristics that will achieve desirable results.
Enter desired subwoofer system response characteristics into subwoofer equalizer.
Equalizer accepts user input describing equalizer response.
Equalizer provides response described by user settings.
Equalizer function
NEW
User action
Obtain information about intrinsic properties of main speakers.
Enter main speaker descriptive information into equalizer.
Equalizer accepts user input describing main speaker properties.
Equalizer calculates main speaker response.
Equalizer determines and provides desirable equalizer response.
Equalizer function

Ballard (US Patent No. 5,617,480)

Ballard discloses "A DSP-based… equalization design system… to… design an equalizer from a… Graphic User Interface…" "The system and method of design provide DSP filter coefficients for use in… DSP-based… equalization hardware." (from the Abstract) The system is an interface between a user who specifies desired equalizer response characteristics and the DSP-based equalization hardware that requires mathematical filter coefficients in order to implement the specified equalizer response. It accepts equalizer response characteristics as user input and delivers as output mathematical filter coefficients that will control an equalizer. "...the audio engineer can make changes to the DSP filter parameters by controlling the visual representation and corresponding signal processing functions until a desired equalizer response is obtained..." (Col 3, line11).

The user specified equalization response characteristics include crossover equalization, parametric equalization and time delays. Most relevant to the present invention is the crossover equalization. "Crossovers icon 62 allows the user to adjust the crossover filter parameters used for the system's subwoofer and satellite channels." (Col 5, line 60) "Fig. 6 shows the crossover screen. It has two frequency scroll tabs, one represents the subwoofer crossover filters and one represents the satellite crossover filters." (Col 8, line 50) The user adjustments illustrated in Ballard's Fig. 6 describe the response of the equalizer. In this case the subwoofer channel's equalizer's response can be selected to be a 4th order or a 2nd order low-pass. The characteristic frequency of this response can also be selected by the user. Similar settings are available for the satellite channel except the response is high-pass. As is also true of the available equalization control that is illustrated in Fig. 5 and other Figures, the user settings in every case are describing the frequency response of the equalizer.

They are not describing anything about the response or characteristics of the speakers that the equalizer is altering the signal of and therefore are not indicative of speaker characteristics. In this respect Ballard is no different than all prior art. Ballard's novelty is in the user interface that facilitates generation of the DSP filter coefficients into the equalizer. The "invention provides the advantage of a simpler and faster design for filter parameters...", "...provide a graphical user interface which substantially simplifies a designer's ...calculation of ... filter parameters..." (Col 3, line 20).

DECLARATION

I hereby declare that all statements made herein are of my own knowledge are true and that all statements are made on information and belief and are believed to be true; and further, that these statements were made with the knowledge that willful false statements and the like so made are punishable by fine or imprisonment, or both, under Section 1001 of Title 18 of the United States Code, and that such willful false statements may jeopardize the validity of the application or any patent issued thereon.

JAMES THIEL		3-20-06
Printed Name	**Signed Name**	**Date**

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